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SUBJECTIVE AND OBJECTIVE STRESS IN CONSTRUCTION COST ESTIMATION

Mei-yung Leung [1] ***and Martin Skitmore*** [2]

[1] *Department of Building and Construction, City University of Hong Kong, Tat Chee Avenue, Kowloon Tong, Hong Kong*

[2] *School of Urban Development, Queensland University of Technology, Gardens Point, Brisbane Q4001, Australia*

Please contact:

Dr. Mei-yung Leung
Department of Building and Construction,
City University of Hong Kong,
Tat Chee Avenue, Kowloon Tong, Hong Kong
Tel: Int+ (852) 2788 7142
Fax: Int+ (852) 2788 7612
Email: bcmei@cityu.edu.hk

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ABSTRACT

Cost estimators play an important role in an organization, as they produce the majority of predictions of probable final construction cost. Care is needed as both under and overestimates can be costly. The nature of the task is also such that the work has to be done in a restricted amount of time. It is likely, therefore, that the people involved are likely to experience a considerable amount of mental and emotional stress as a result.

Types of stress can be divided into objective stress (OS), occurring as a result of events experienced, and subjective stress (SS) and emotional exhaustion (EE), which are a function of the demands of the situation created by those events. Since stress may be influenced by different stressors, and subsequently affect the type of stress management needed, the research described in this paper examined the relationships between OS, SS, EE and stressors by a survey of 73 construction cost estimation personnel. T-test, factor analysis, correlation analysis and linear regression analysis were applied to identify differences between the professional estimators and other personnel and the types of stress endured.

The results indicate that the stress levels of both the professional estimators and other personnel are similar, with OS being significantly higher than SS, which is in turn significantly higher than EE. For professional estimators, increased levels of OS were found to be mainly associated with *workload*, *lack of autonomy* and inappropriate *feedback*. Increased SS and EE, on the other hand, appeared to be a function of *conflict* (team/value/family), *distrust*, inappropriate *feedback*, and *unfair reward and treatment.*

Keywords: Cost estimator; emotional exhaustion; objective stress; subjective stress; stress; stressors.

INTRODUCTION

Both client/owners and constructors need to be informed in advance of the likely costs of construction work. For constructors, successful bidding is critical for the survival and this depends to a large extent on estimates of project cost to the constructor (e.g., Skitmore 1989). Underestimates, for example, are more likely to win loss-making contracts, while overestimates are likely not to win any contracts at all. Estimates of client/owner costs are no less important, as underestimates imply cost overrun while overestimates often deny value for money.

The size and complexity of construction work is such that several personnel are often involved in producing estimates. These include cost estimators, engineers, planners and other procurement staff. Both client/owners and constructors need to keep the time spent in estimating to a minimum. For client/owners, an extended pre-tender period is an unwelcome interference in the procurement process, while for constructors, a lengthy and expensive estimating process simply adds to the overheads for unsuccessful bids. Typically, therefore, the estimating personnel need to tightly work together as a team for a short and fixed pre-tender period.

In such circumstances, it is not surprising that cost estimation is regarded by many as a highly stressful task for the personnel involved, especially the cost estimators themselves, whether employed by constructors for bidding or by client/owners for budgetary monitoring and control. It is therefore important to understand the effects of stress and, if significant, how and to what extent it might be ameliorated.

Research to date has been concerned with the relationship between individual coping behaviour and relative working performance (Leung and Lam 2004; Leung and Wong 2004), with stress being evaluated by the deviation between the expected and actual abilities to perform certain tasks (Leung 2004; Leung *et al* 2005, 2006b, 2006). Clearly, this kind of stress focuses on event-related feelings, and therefore evaluates stress in an objective way. However, stress is not a product of events alone but a function of both the events and the subjectively defined demands of the situation created by those events (Lazarus 1966). These are termed *subjective stress* (SS) and *emotional exhaustion* (EE) to distinguish them from events related *objective stress* (OS). The aspect of stress measured by earlier work, therefore,

was limited to the frequency of stressor events within social systems (Linsky 1995). As a result, the underlying rationale for the research reported in this paper was that:

1. In addition to event-related OS, the level of stressful life-events also influence the estimators' stress through some psychological process.
2. Different stress levels exist between OS, SS and EE.
3. Different stress levels exist between professional estimators and other estimating personnel.
4. Different types of stress are induced by different stressors.

OS, SS AND EE

OS and SS

Stress is regarded by many as neither contained in the person nor in the environment, but in the relationship between the two (Lazarus 1990; Straus 1973), and therefore includes job characteristics, organizational structure, and social relationships. Hence, stress is likely to occur when there is conflict between the individual and environment (Riley and Zaccaro 1987). As a transaction, stress is also a dynamic and ongoing process (Lazarus 1991; Dewe *et al* 1993). The individual interacts with the environment and continuously adjusts to better cope with the stress.

Stress is the general concept describing a '*load*' on the system. This includes external and internal factors. External factors are considered to cause the OS while SS is seen as resulting from internal factors (Laplante *et al* 2004; Rodney 2003). OS mainly focuses on the evaluation of the events happening around the person concerned. For estimation personnel, these include such events as the number of deadlines, number of projects, etc. SS, on the other hand, is mainly evaluated by the degree of satisfaction with the environment, including feelings of happiness or depression, confidence in the organization, etc. Hence, SS is measured as the degree by subjective impact experienced as a result of a specific event (Horowitz *et al* 1979), while OS refers to a negative discrepancy between an individual's received state and desired state (Edwards 1988).

EE

EE is closely related to *job burnout*. Job burnout has many definitions, most of which accept that burnout is caused by prolonged job stress. That is, job burnout is a gradual process due to prolonged exposure to stressful work conditions in which a formerly productive and committed worker loses all interest in his or her job or profession. The person experiences physical and EE, lack of interest in work, and detachment from colleagues (Goliszek 1992). Burnout is viewed as a process comprising the sequence of three components: (1) *EE*, (2) *cynicism* and (3) *efficacy* and these have been investigated extensively. Three major approaches used to date are due to Maslach, Golembiewski and Byrne-Lee-Ashforth.

Maslach's approach

Originally, Maslach (1978) suggested that EE would appear first due to the excessive and chronic demands of the person's work. This then results in a second stage, termed depersonalization or cynicism, in which the person attempts to psychologically withdraw from the work and any parties involved. Cynicism is viewed as a defensive coping behaviour that depletes the person's energy resources further (Lee and Ashforth 1996). Finally, the person realizes the discrepancy between his working attitude and the expectation of his contribution to the organization or society and may feel a decline in competence and a lack of achievement and productivity at work. This is the stage of reduced personal accomplishment or efficacy.

Golembiewski's approach

Golembiewski (1989) suggests that cynicism is the first element to appear in the burnout process and this, in turn, causes the individual to have a diminished feeling of efficacy because of his defensive coping behaviour. Finally, this results in a high level of EE with a significant reduction in efficacy.

Byrne-Lee-Ashforth's approach

In this case, inefficacy is viewed as a function of either EE, cynicism or a combination of the two (Byrne 1994; Lee and Ashforth 1996). The researchers found that work situations with chronic demands that contribute to exhaustion and cynicism can affect one's working effectiveness. It is clearly hard to gain efficacy if the individual is extremely exhausted and cynical.

Stressors

Stressors are the sources of stress. They can be events, people or thoughts which lead a person to perceive some threatening demands are being made on him (Riley and Zaccaro 1987). Generally, stressors can be classified into four different types: (inter) personal, task, organizational and physical stressors (Leung 2004; Leung *et al* 2005). Personal stressors may be related to the person's genetic make up, family background, personality traits, cultivated habits and environmental influences (Khanna 1998). The person's working relationships and the social support available from colleagues, bosses, and subordinates are related to interpersonal stressors. A poor working environment is a physical stressor (Quick *et al* 1997; Driskell and Eduardo 1991). Task characteristics can be associated with stress and treated as stressors if the work demands exceed the resources available (French and Caplan 1973; French *et al* 1974; Schuler 1980; Kahn and Byosiere 1990). Organizational stress is concerned with the policy and climate in an organization. Policies made without concern for workers' feelings can cause great stress (Karasek *et al* 1981).

RESEARCH METHOD

Following informal unstructured interviews, a questionnaire was developed and trialled with a variety of construction cost estimation personnel. Two hundred sets of questionnaires were distributed by fax, email or in person to construction cost estimation personnel working in a variety of organisations including developers, consultant firms, public sector organisations, main contractors and subcontractors. There were seventy-three respondents in total - a return rate of 36.5%.

SS and EE were evaluated on a seven-point Likert scale ranging from 1 to 7, expressing the stress from 'none' to 'a great deal' (Banks *et al* 1980; Maslash and Jackson 1996). To measure the level of OS, Gmelch (1982) has proposed using the deviation between expected and actual abilities when people encounter the stress. Stress would therefore become apparent when the actual abilities are lower than expected (Kahn *et al* 1964; French and Caplan 1973; McGrath *et al* 1989; Schuler 1980). The respondents were then asked to rate their actual (a) and expected (b) abilities on the same scale. The overall level of the stress was taken to be represented by sum of the differences between (a) and (b) ratings.

T-tests were first carried out to compare the means of the OS, SS and EE, and then to check the different stress level between the various personnel involved. For the analysis, two respondent groups were defined: 'professional estimators' (PE) and 'other personnel' (OP). Fifty-four of the respondents were contractors' estimators and quantity surveyors, who formed the PE group (quantity surveyors were classified into this group as they acted as part-time estimators for pricing tenders), with the OP group being made up of the remaining nineteen estimating-related respondents, comprising planners, engineers, project managers, procurement staff, contract managers and directors. As a check on the sensitivity of the grouping arrangement, this was repeated again later but with only the contractors' estimators comprising the PE group and all the remaining respondents comprising the OP group. A third repetition was also done with the contractor and developer estimators comprising the PE group and the remaining respondents again comprising the OP group. Only the results of the first grouping arrangement are reported in this paper. It should be noted, however, that all three grouping arrangements produced very similar results in terms of statistical significance.

Factor analysis was then used to classify the stressors into ten factors. Correlation analysis was employed to find the relationship among stress, stressor, organizational support and performance. Linear and curve regression analyses were then done to identify the above relationships. In all cases, statistical significance was judged at the conventional 5% level.

DATA ANALYSIS AND FINDINGS FROM QUANTITATIVE DATA

T-tests on OS, SS and EE

Paired-sample t-tests were conducted to ascertain if the mean stress levels were significantly different between the PE and OP groups of respondents. The OS and SS, SS and EE results, together with their Eta squared values are summarised in Table 1. For the PE group, the difference in mean between OS and SS is -4.981, the mean of the OS (51.967) being significantly greater than that of SS (46.986) - indicating that the PE respondents experience more OS than SS. The Eta squared is 0.191, indicating a large effect. As with the PE group, the OP group are more affected by OS than SS, with a significant difference in means of -6.730. The Eta squared in this case is 0.242, again indicating a large effect. In general, it was found that OS has the highest mean followed by SS and with EE being the lowest.

< Table 1 >

The independent t-test was used to test for differences between the PE and OP groups (Table 2). Although the means of the PE group are higher than OP group, these are not statistically significant. As a result of these, both the PE and OP groups were combined into one group for further analysis.

< Table 2 >

Factor Analysis on Stressors

Because of their different natures in similar questions, the scores for items 2, 24, 29, and 33 were reversed before doing the factor analysis. The data were analyzed by principal components analysis, with varimax rotation (eigenvalue=1 cut-off) on the stress-related variables. This resulted in eleven factors. In order to ensure similar characteristics for each category, only those variables with factor loadings greater than 0.5 were retained (Hair 1992). These, together with the coefficient alpha reliabilities, are listed in Table 3.

< Table 3 >

The alpha of factor 11 is the lowest (0.438) of all and out of the acceptable range and was therefore deleted. Furthermore, items 4, 13, 30 were deleted from F1, F4 and F9 respectively, increasing their alpha reliabilities substantially. The original 'work overload' are converted into 'work underload' factor (F1) by changing the direction of factor loadings from positive to negative, while a 'job ambiguity' item and two 'job insecurity' items combine together and form 'job insecurity/ambiguity' factor (F3). In summary, the items are allocated into the ten factors appropriately.

The resulting ten factors are further classified into four groups (see Table 4): (1) Organization-related, (2) Task-related, (3) (inter)Personal-related and (4) Physical-related. 'Physical setting' (F2) is the only factor in the physical-related group. 'Unfair reward and treatment', 'lack of autonomy' and 'lack of feedback' are classified into the Organizational-related group; while 'work underload'[1] and 'job security/ambiguity' are treated as part of the Task-related; (inter)Personal-related group includes 'type A behaviour' and 'distrust'. Since items in 'conflict' factor cover team conflict (item 11) and value conflict (12), it involves both organisational- and personal-related stressors. 'Work-family conflict' factor obviously involves both personal- and task-related stressors.

< Table 4 >

Pearson Correlation Analysis and Regression Analysis

Bivariate correlation and stepwise regression analysis were used to identify relationships between stresses and stressors. The Pearson correlation results (Table 5) indicate that SS is significantly correlated with 'role conflict' (0.299), 'lack of autonomy' (0.357), 'work-family conflict' (0.449) and 'distrust' (0.260). For the correlation between OS and stressors, only 'lack of autonomy' (0.412) is significant, while EE is significantly correlated with 'work underload' (0.447), 'job insecurity/ambiguity' (0.327), 'role conflict' (0.286), 'unfair reward and treatment' (0.438), 'lack of autonomy' (0.518), 'work-family conflict' (0.242) and distrust' (0.269).

[1] 'Work Underload' is regarded as a stressor here as it is frequently a source of stress for the individual (Cox 1978; Cotgrove and Box 1970) – a complete absence of work pressure of any sort is known to create a psychologically comfortable state (Keenan 1980).

< Table 5 >

For the regression results (Table 6), 'work-family conflict' is the first factor entering into the regression model for SS for the estimator group. Thereafter, 'lack of autonomy' enters into the model. These two stressors explain 27.4 percent of the SS variance. For OS, 'lack of autonomy' and 'lack of feedback' enter the equation, explaining 21.5 percent of the OS variance. 'Lack of autonomy' and 'unfair reward and treatment' enter the EE equation, explaining 36.9 percent of EE variance.

< Table 6 >

Separating the PE and OP groups, however, provides a clearer picture (Tables 5 and 6). In this case, the Pearson correlation results (Table 5) indicate OS, SS and EE generally to be significant correlated with more stressors in the PE group than the OP group. SS is significantly correlated with 'conflict' (0.327), 'lack of autonomy' (0.303), 'lack of feedback' (-0.441) and 'work-family conflict' (0.486) for the PE group while only 'lack of autonomy' (0.485) is significantly correlated for the OP group. For the correlation between OS and stressors, 'lack of autonomy' (0.425) is significant for the PE group. EE is significantly correlated with 'work underload' (0.429), 'job insecurity /ambiguity' (0.316), conflict' (0.311), 'unfair reward and treatment' (0.402), 'lack of autonomy' (0.566) and distrust' (0.290) for the PE group; and 'work' underload' (0.563) and 'unfair reward and treatment' (0.530) for the OP group.

For the regression results (Table 6), 'work-family conflict' is the first factor entering into the regression model for SS for the PE group. Thereafter, 'conflict' and 'lack of feedback' enter into the model. These three stressors explain 40.8 percent of the SS variance. 'Lack of autonomy' is the variable entering the equation for the OP group. For OS, 'lack of autonomy', 'work underload' and 'lack of feedback' enter the equation for the group, explaining 31.7 percent of the OS variance. No variables entered the equation for the OP group. 'Lack of autonomy', 'unfair reward and treatment' and 'distrust' enter the EE equation for the PE group, explaining 47.5 percent of EE variance. For the OP group, only 'work underload' enters the equation with a 31.7 percent explanation.

DISCUSSION

Different types of stress

The study revealed that stress should not be simply used as a one-dimensional feeling among estimation personnel. Stress is multi-dimensional (SS, OS and EE) in cost estimation. The results indicate that the means of OS are significantly higher than that of SS, and the means of SS are significantly higher than EE. This may be because the tasks undertaken by the estimators are mainly of an objective nature, such as calculating, planning and organising. Therefore, compared with SS and EE, which come from the environment, OS from the task is more likely to be present. Presumably, EE has the least possibility of occurring as it is known to be burnout due to prolonged job stress.

Stress level of the PE and OP groups

From the independent t-test analysis, the hypothesis of different stress levels in PE and OP groups was rejected. That is to say, the professional estimators and other personnel (by a variety of definitions) can be regarded as having the same stress levels, including SS, OS and EE. In the estimation stage, both groups are involved in the process and therefore are presumably subject to similar amounts of stress via both the overall task in hand and the environmental influences that occur.

Significant effects of stressors on OS, SS and EE

As the analysis shows, the PE group are much clearer about the stressors involved than the OP group, with the r^2 regression results increased for the PE grouping alone – perhaps because the PE respondents, being professionals, have learned to recognise and anticipate potentially stressful situations in order to better manage them. Their responses, therefore, are likely to be closer to the truth than those of the OP group.

For the PE group, SS is mainly caused by ‘conflict’, ‘lack of feedback’ and ‘work-family conflict’, while OS is reduced by ‘lack of autonomy’, ‘workload’ and lack of autonomy’. EE is caused by ‘unfair reward and treatment’, ‘lack of autonomy’ and ‘distrust’ and related to ‘conflict’, ‘workload’ and job insecure/ambiguity’.

Conflict

Conflict contributes both a functional and dysfunctional impact on construction projects; therefore it cannot be simply eliminated (Leung *et al* 2005). However, the study revealed that conflicts between supervisors and staff (team conflict), constant pressure to work (task conflict), different beliefs to those of the organization (value conflict) and conflicts between work and family lead estimators to SS. Hence, all kinds of 'conflict' (team and value conflicts for F4; and work-family conflict for F9) are considered excessive.

Lack of autonomy

'Lack of autonomy' is positively related to the stress perceived by all kinds of estimation personnel, and is the only stressor correlated with all three types of stress. Without adequate autonomy, estimators find it difficult to carry out their job effectively. Therefore, 'OS' is induced. People under chronic stress or being unable to deal with chronic stress, the people affected are likely to tend to EE, the major and initial dimension of burnout (Leiter and Harvie 1996; Maslach and Leiter 1997; Lloyd and King 2001).

Distrust

Estimation emphasises teamwork in the overall process, especially for complicated construction projects. It is difficult for estimators who do not trust others. On the contrary, they may be insufficiently motivated to perform well in their work if they are not trusted in the team – which suggests that 'distrust' will be another cause of EE.

Unfair reward and Job insecurity/ambiguity

Among the three types of stress, the results indicate that EE is the one influenced by most of the stressors. Apart from the above stressors, EE is also affected by 'unfair reward and treatment' and 'job insecurity/ambiguity'. Insecure job and unfair reward and treatment may make the estimating personnel unclear/dissatisfied with their jobs and feel the reward they receive is not sufficient compensation for the effort and time they put into their work.

Feedback and Workload

Two interesting points are revealed in the study. Firstly, *Feedback* causes both SS and OS. Feedback can clarify uncertainty and improve subsequent tasks (Leung *et al* 2004), but simultaneously causes stress subjectively and objectively. Estimators have high expectation (e.g., more accuracy, higher bidding opportunity, etc.) if more information is received during the estimation process. Secondly, *Workload* induces OS but work underload relates to EE. The working performance does not achieve the expected performance. The gap between the expected and actual performance (i.e. OS) is thus increased with work overload (i.e. negative work underload) (Leung *et al* 2005a, 2005b). However, estimators only feel EE when they have insufficient work or feel their work boring and repetitive.

The Model

In total, eight out of eleven stressors are related to the three types of stress. The identified relationships among SS, OS, EE and stressors are summarised in Figure 1.

< Figure 1 >

RECOMMENDATION

Practical Implications

The results suggest that senior managers need to allow sufficient autonomy and discuss/chat about the tasks, personal values and family life with individuals as a means of reducing conflict and optimising the stress of estimating personnel in the industry. *Formal activities* (e.g., regular meeting, performance appraisal and value management workshop) should help to review the daily tasks and the workload allocated, while *informal activities* (e.g., buffet, barbeque, Karaoke, etc.) provide a means of building up trusting relationships among team members (Leung *et al* 2005b).

On the other hand, a *fair and systematic promotion and awarding system* (Tsutsumi and Kawakami 2004) helps reduce SS, OS and EE. Estimation personnel have a key role in

ensuring profitable construction projects for the company and their professional input is likely to have significant influence on company profitability. Construction senior managers, therefore, should benefit from regular reviews of the external professional market and individual contributions, with promotion and rewarding systems reflecting individual efforts and contributions.

Experienced estimators can provide accurate estimates of building prices and legal advice for projects. Therefore, feedback is clearly needed in the process. In order to avoid unnecessary stress, senior managers are advised to allow sufficient *flexibility* for estimators to make decisions based on their own information. Alternatively, a *two-way feedback process* (from estimation personnel to managers and from managers to estimation personnel) may be possible.

Research Implications

Although some potentially useful findings regarding the three types of stress were revealed in the study, there are potential limitations in our research design that should be noted. For example, the relatively small sample used for this study may limit the generalisability of the results. However, all the respondents in this survey were identified through membership records of the Hong Kong Institute of Surveyors and the Royal Institute of Chartered Surveyors and have direct experience of construction estimation. Therefore, it is unlikely that the results are biased by differential response to the measured variables. Indeed, they reflect the experience of normal practice in the industry and could provide useful baseline information for large-scale studies in the future.

The causal relationships postulated are partially supported by the analytical techniques used, but in need of further research. For example, the quantitative data analysis undertaken provides the context and support for subsequent qualitative studies (e.g., case studies). These can be used to cross-validate the relationship between stressors and different types of stress in real projects, since lateral studies can only be effective when confounding variables are constrained and controlled. Triangulation may, therefore, be employed to provide the necessary 'leverage' to assist in obtaining a better understanding and generalisation through exploratory case studies, lateral research and their interaction.

In sum, the results confirm the previous study (Leung *et al* 2005b) that 'conflict', 'job ambiguity' and 'workload' are stressors influencing the stress levels of estimation personnel. However, 'physical setting' has no correlation to SS, OS or EE in the present study while it was one of the major stressors influencing stress in previous studies. Further study of this may be beneficial in the future.

CONCLUSIONS

Estimation personnel experience different levels of stress type, with OS level being the highest, followed by SS and then EE, possibly due to the tasks involved being mainly of an objective nature, such as calculating, planning and organising. Hence, the determination of OS and management of the relevant stressors would be the first step to take in managing the stress of estimation personnel. However, it is clear that SS and EE need to be considered in addition to OS in order to fully understand the stress of estimation personnel. The study revealed that the OS of professional estimators mainly derive from 'workload', 'lack of autonomy' and 'feedback', while 'conflict', 'feedback', 'work-family conflict', 'lack of autonomy', 'unfair reward and reward and treatment' and 'distrust' also lead to SS and EE, which would have been overlooked had the research been concerned solely with OS.

In order to optimize stress of estimation personnel, senior estimating managers are recommended to hold formal meetings/workshops for task allocation and revision, set a fair and systematic promotion/reward system, ensure a 2-way feedback process with sufficient flexibility, be concerned with personal and organisational values in the estimation process and arrange activities for staff as well as their families.

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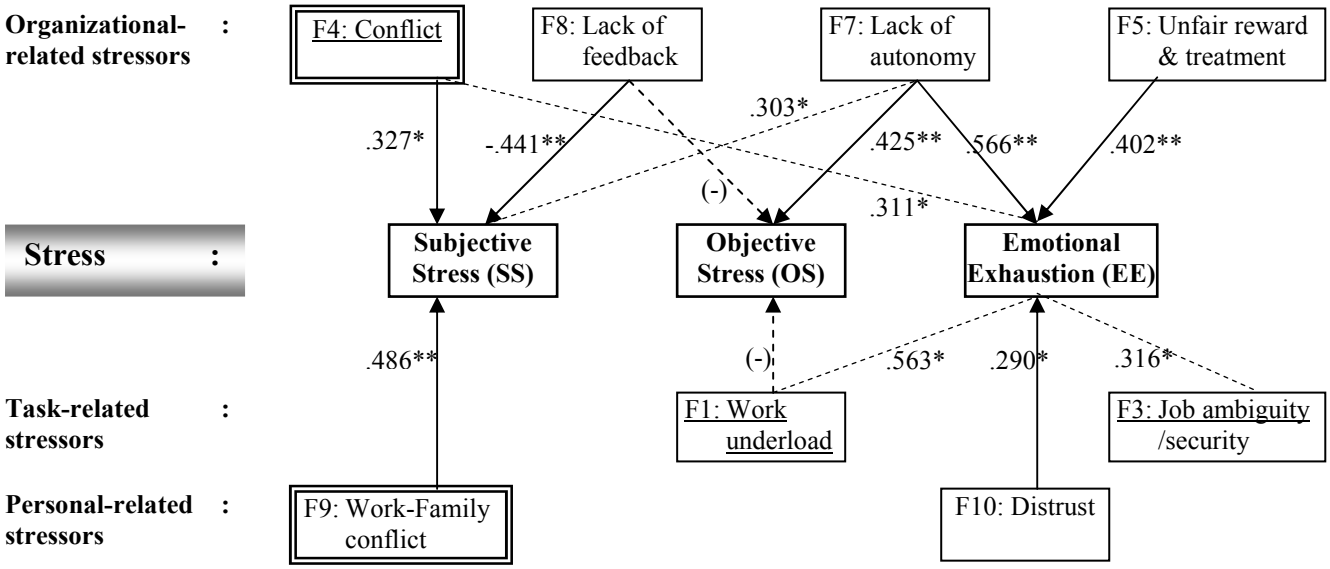

Figure 1 Causal Models of Stressors–Stress (SS/OS/EE) for Professional Estimators

Note: ⟶ - causal relationship reveals in both correlation analysis and regression model.
⇢ - causal relationship reveals in regression model.
\- - - - - - - - - causal relationship reveals in correlation analysis.

Figure on the lines represent the correlation coefficient (refer to Table 5).

* Correlation is significant at the 0.05 level (2-tailed) ; ** Correlation is significant at the 0.01 level (2-tailed).

(-) represents the negative coefficient in the regression model.

F4: Conflict covers team conflict (item 11) and value conflict (12), therefore F4 involves both organisational- and personal-related stressors.

F9: Work-Family conflict involves task-and personal-related stressors.

Stressor underlined is major stressors influencing stress in previous (Leung et al. 2005).

Table 1 t-test among SS, OS and EE

Estimation personnel	Paired Stress (X-Y)	Mean Score X	Mean Score Y	Mean Differences	t	df	Sig. (2-tailed)	Eta squared
PE	SS -OS	46.986	51.967	-4.981	-3.507	53	0.001	0.191
	SS -EE	46.986	32.106	14.881	7.395	53	0.000	0.513
	EE-OS	32.106	51.967	-19.861	-11.238	53	0.000	0.708
OP	SS -OS	43.770	50.500	-6.730	-2.332	18	0.032	0.242
	SS -EE	43.770	31.047	12.722	4.254	18	0.000	0.516
	EE-OS	31.047	50.500	-19.453	-6.333	18	0.000	0.702

Table 2 t-test for two groups

Stress	Mean			Levine's Test for Equality of Variances		t-test for Equality of Means		
	PE	OP	Difference	F	Sig.	t	df	Sig. (2-tailed)
SS	46.986	43.770	3.216	0.085	0.772	0.994	71	0.324
OS	51.967	50.500	1.467	2.214	0.141	1.099	71	0.275
EE	32.106	31.047	1.058	0.022	0.882	0.294	71	0.770

Table 3 Scale Items, Factor Loadings and Coefficient Alpha Reliabilities for the Stressors

Factors		Nature	Items	Factor loading	Alpha
F1	Work Underload	-	1. I feel my skills and abilities are not being used well.	0.817	0.745
		+	2. I have opportunity to participate in decisions that affect my job.	- 0.651	
		-	3. I frequently find my work boring and repetitive.	0.651	
		-	~~4. I have a lot of responsibility in my job.~~	~~- 0.521~~	
F2	Physical Setting	-	5. The lighting in office is too dim.	0.877	0.856
		-	6. My office is too noisy.	0.855	
		-	7. My office is too crowded.	0.839	
F3	Job Inescurity /ambiguity	-	8. I have no clear idea about future job tenure.	0.769	0.772
		-	9. It is likely that I will lose my present job during the next couple of years.	0.746	
		-	10. My job responsibilities are generally vague, unclear and inconsistent.	0.608	
F4	Conflict	-	11. I am often caught between conflicting demands from my supervisor and staff..	0.798	0.724
		-	12. My beliefs often conflict with those of the organization.	0.711	
		-	~~13. There is constant pressure to work every minute, with little opportunity to relax.~~	~~0.598~~	
F5	Unfair Reward and Treatment	-	14. I find the reward I get does not balance with the effort I pay.	0.806	0.739
		-	15. I find the reward I get is relatively low when comparing with the external market.	0.700	
		-	16. I often feel unfair for the organization treatment.	0.698	
F6	Type A Behavior	+	17. There are trustworthy person who I could turn for advice if I was having problems.	0.785	0.675
		+	18. I feel well supported by my friends and/or family.	0.564	
		+	19. I demand o lot of the quality of my work.	0.550	
		+	20. I do not go home before I have finished what I have planned.	0.502	
F7	Lack of Autonomy	-	21. I have to refer matters upwards when I could really deal with them adequately myself.	0.756	0.766
		-	22. I am given insufficient authority to do my job properly.	0.683	
		-	23. My boss often deals with me in an autocratic and overdemanding manner.	0.637	
F8	Lack of Feedback	+	24. I can get feedback from my supervisor on how well I am doing.	- 0.802	0.735
		-	25. It is hard to receive information from my supervisor on my job performance.	0.784	
		-	26. I have no opportunity to find out how well I am doing on my job.	0.582	
F9	Work-Family Interface Conflict	-	27. My family/friends would like me to spend more time with them.	0.734	0.556
		-	28. My devotion to work is usually in conflict with my devotion to family.	0.637	
		+	29. I have freedom to do pretty much what I want on my job.	- 0.589	
		+	~~30. I am an achievement-oriented person who has the need to win.~~	~~- 0.581~~	
F10	Distrust	-	31. There often seems to be a lack of trust between myself and my subordinates.	0.870	0.794
		-	32. I seldom delegate tasks because others cannot complete the tasks as well as I can.	0.751	
F11	Role Ambiguity	+	33. I understand exactly what is expected of me.	- 0.798	0.438
		-	34. I am not sure I have divided my time properly among task.	0.541	

Note: 1. All items were measured on a 7-point scale ranging from disagree strongly to agree strongly.
2. Cumulative variance = 75.85%.
3. Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.
4. ~~Items~~ with strikethrough were deleted in order to increase their alpha reliabilities substantially.

Table 4 Classification of Stressors

	Factors (stressors)	Organizational	Task	(inter)personal	Physical
F1	Work underload		√		
F2	Physical setting				√
F3	Job insecurity / ambiguity	√			
F4	Conflict	√		√	
F5	Unfair reward and treatment	√			
F6	Type A behavior			√	
F7	Lack of autonomy	√			
F8	Lack of feedback	√			
F9	Work-Family conflict			√	
F10	Distrust			√	

Table 5 Correlation between Stressors and Stresses

Estimation personnel	Dependent	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
ALL	SS	0.109	-0.144	0.199	0.299*	0.145	-0.096	0.357*	-0.211	0.449**	0.260*
	OS	0.041	-0.012	0.163	0.036	0.197	-0.044	0.412**	-0.180	0.214	0.036
	EE	0.447**	0.021	0.327**	0.286*	0.438**	0.023	0.518**	0.031	0.242*	0.269*
PE	SS	-0.015	-0.160	0.109	0.327*	0.143	-0.016	0.303*	-0.441**	0.486**	0.231
	OS	-0.040	-0.103	0.105	0.033	0.271	-0.011	0.425**	-0.263	0.203	-0.039
	EE	0.429**	-0.046	0.316*	0.311*	0.402**	0.077	0.566**	-0.134	0.223	0.290*
OP	SS	0.441	-0.124	0.380	0.254	0.094	-0.288	0.485*	0.322	0.405	0.282
	OS	0.271	0.265	0.306	0.068	-0.068	-0.111	0.312	0.053	0.315	0.201
	EE	0.563*	0.190	0.352	0.222	0.530*	-0.137	0.364	0.490	0.313	0.207

Note: * Correlation is significant at the 0.05 level (2-tailed); ** Correlation is significant at the 0.01 level (2-tailed).
F1 –F10 refer to Tables 3 and 4.

Table 6 Regression Analysis between Stress and Stressors

Estimation personnel	Dependent	Model	Unstandardised Coefficients		t	Sig	R	R Square
			B	Std. Error				
ALL	SS	(Constant)	20.602	4.814	4.280	0.000		
		F9 Work-Family conflict	1.201	0.320	3.754	0.000	0.523	0.274
		F7 Lack of autonomy	0.778	0.294	2.643	0.010		
	OS	(Constant)	-4.352	3.273	0.125	0.188		
		F7 Lack of autonomy	0.834	0.207	4.034	0.000	0.464	0.215
		F8 Lack of feedback	-0.424	0.211	-2.005	0.049		
	EE	(Constant)	1.727	2.039	0.847	0.400		
		F7 Lack of autonomy	0.568	0.128	4.437	0.000	0.607	0.369

		F5	*Unfair reward & treatment*	0.499	0.149	3.348	0.001		
PE	SS		(Constant)	34.782	7.491	4.643	0.000	0.639	0.408
		F9	*Work-Family conflict*	0.738	0.381	1.938	0.058		
		F4	Conflict	1.718	0.534	3.217	0.000		
		F8	Lack of feedback	-1.043	0.367	-2.840	0.007		
	OS		(Constant)	0.541	4.343	0.125	0.901	0.563	0.317
		F7	*Lack of autonomy*	1.102	0.262	4.213	0.000		
		F1	Work underload	-0.586	0.24	-2.445	0.018		
		F8	*Lack of feedback*	-0.543	0.246	-2.208	0.032		
	EE		(Constant)	-2.895	2.755	-1.051	0.298	0.689	0.475
		F7	*Lack of autonomy*	0.607	0.135	4.499	0.000		
		F5	*Unfair reward & treatment*	0.593	0.174	3.414	0.001		
		F10	Distrust	0.370	0.179	2.063	0.044		
OP	SS		(Constant)	24.202	8.501	2.847	0.011	0.485	0.236
		F7	*Lack of autonomy*	1.648	0.72	2.289	0.035		
	EE		(Constant)	5.417	3.198	1.694	0.108	0.563	0.317
		F1	*Work underload*	0.917	0.327	2.808	0.012		

Note: *Variables in Italic* appear in 'ALL and PE models' or 'ALL and OP model'.